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RECENT AND CURRENT WATER POLLUTION CONTROL ACTIVITIES

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The results of water pollution control activities of the Environmental Health Center are reflected in the list of publications issued in May 1950, and the supplement issued on November 30, 1950. These publications represent results of activities of the Center in the past. Recent and current activities will, in the future, be reflected in similar publications and special reports.

This report presents, in brief, the recent and current water pollution control activities and brings the formal record of such work up to the minute.

This presentation is organized according to branches of the Center and by sections of the various branches. For that reason when more than one section and branch has cooperated on an activity there may be some apparent repetition.

The branches and sections represented in this report, with corresponding project numbers, are as follows:

RESEARCH AND DEVELOPMENT BRANCH
Nos.1-20 Physics and Chemistry Section
Nos.21-30 Biology Section

SURVEY AND INVESTIGATION BRANCH
Nos.31-40 Field Survey Section
Nos.41-47 Industrial Wastes Section

Additional work indirectly connected with pollution is being conducted by the Bacteriology and Shellfish Sections of the Research and Development Branch. Most of these activities are concerned with bacteria either serving as organisms indicating pollution or causing harmful effects in man or his environment.

RESEARCH AND DEVELOPMENT BRANCH

Physics and Chemistry Section

1. Determination of Trace Quantities of Pyridine and Certain Pyridine Bases in Polluted Waters. (C-1-1).

Trace quantities of pyridine, beta-picoline and other pyridine bases may be determined by their reaction with cyanogen bromide and benzidine.

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15. Supplementary Notes

16. Abstracts This report briefly updates the continuing water pollution control activities of the various branches and sections of the Environmental Health Center. It presents chemical and physical analyses of polluted waters and discusses a study of the pollution and self-purification of Lytle Creek, Wilmington, Delaware. It presents the effects of wastes on the fish in the areas and evaluates biological indicators for the Lytle Creek area. Other areas investigated include the South Platte River Basin, Mississippi River, Etowah River, Mahoning River and the Roanoke River. The report discusses industrial wastes and gives status reports for a variety of these wastes.

17. Key Words and Document Analysis. 17a. Descriptors

17b. Identifiers/Open-Ended Terms

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17c. COSATI Field/Group 13B

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These bases are present in wastes from by-product coke plants and some oil refineries. In order to get quantitative results, the reaction must be carefully controlled and carried out in the dark. It is necessary to have butyl alcohol present during the reaction. The colored reaction products form in the alcohol phase. A few p.p.b. of the more reactive compounds, such as pyridine and beta-picoline, may be determined.

The study is essentially completed and first draft of a manuscript prepared. The report should be available about June 1, 1951.

2. Sensitizing the 4-aminoantipyrine Reaction with Phenolic Materials for Use in Water and Waste Analysis. (C-1-2).

This work is a study of the variables in a relatively new reaction for the determination of phenols. The reaction has been studied to determine the reaction conditions for accuracy, specificity and sensitivity. By extraction of reaction products, coupled with carefully controlled work, a sensitivity of 2 p.p.b. may be obtained.

A paper on this subject was presented at the American Chemical Society meeting in Chicago on September 5, 1950, and has been submitted for publication in Analytical Chemistry. Mimeographed copies are available.

3. The Effect of Stepwise Chlorination on the Taste and Odor Producing Intensity of Some Phenolic Compounds. (C-1-3).

The effect of stepwise chlorination on the taste intensity of a number of the simpler phenols was studied. In the case of the phenols, which are important sources of taste and odor, chlorination first greatly increases the taste. Further chlorination reduces taste to the point where it cannot be detected.

This project was completed in June, and a paper of the above title has been submitted for publication in Journal of the American Water Works Association.

4. Persistence of Pyridine Bases in Sewage and Polluted Waters. (C-1-6).

This work is an evaluation of the persistence of pyridine bases in sewage and polluted surface waters. Pyridine, beta-picoline and other pyridine bases have been observed to be subject to biological attack in aerobic waters. The resistance characteristics of these compounds seem to be largely dependent upon the "seed" organisms present. With the proper "seed" present, they are quickly attacked. Otherwise they may persist for long periods.

This project is about 50 percent completed and a report should be available by September 1, 1951.

5. Distilled Water vs. Demineralized Water for Use as a Dilution Water. (C-2-3).

Distilled water, as a base for dilution water to be used in the B.O.D. test, is relatively expensive and the water from some sources and stills may contain copper or chlorine which interfere with the test. Demineralized water can be produced more rapidly and less expensively than distilled water, and this study was designed to compare the results obtained by the B.O.D. test using domestic sewage with the two types of water. Although demineralized water gave slightly higher D.O. utilization in blanks, there is very little difference in the B.O.D. results, provided the demineralizer is properly regenerated.

Laboratory work and a preliminary draft of a report have been completed. The report should be available in March, 1951.

6. The Use of Oxygenated Dilution Water in the B.O.D. Test. (C-2-5).

With ordinary buffered dilution water, aerated to 8 - 9 p.p.m. of dissolved oxygen, dilutions for the 5-day B.O.D. test with raw domestic sewage usually required are 1 to 100 or 1%. This magnifies any errors in the computation of B.O.D. because of the large multiplying factor. Oxygenated dilution water, containing about 35 p.p.m. D.O. permits setting up sewage samples in 7 - 10% concentration. Comparison of results with aerated and oxygenated waters indicates in preliminary tests that there is little difference in the B.O.D. values obtained.

This project will continue for approximately a year.

7. The Determination of Chromium in Water and Industrial Wastes. (C-2-6).

Various methods for the determination of hexavalent and total chromium in well waters and effluents from chromium plating plants are being investigated. This is a cooperative project between the U.S. Public Health Service, the State of New York, and Nassau County in New York. The results to date indicate that the perchloric acid method of Standard Methods and the common alkaline-bromate method are ineffective in the determination of total chromium.

This project will continue until a procedure satisfactory to the cooperating laboratories is developed.

8. A Study of the Pollution and Self-Purification of Lytle Creek. (C-2-7).

This is a cooperative and continuing study with the Biology and Bacteriology Sections on a small creek receiving domestic sewage. The analyses of samples consist in determination of 5-day B.O.D., 10-day B.O.D., the various nitrogenous constituents, phosphates, alkalinity, chlorides, oxygen consumed and pH. The chemical and biochemical data are then compared with biological and bacteriological findings to give the entire pollution picture under various temperature and flow conditions.

9. The Relation Between B.O.D. and Oxygen Consumed of Industrial Wastes. (C-2-8).

With those industrial wastes that are fairly constant in composition and which contain no compounds toxic to bacteria a satisfactory ratio between the B.O.D. and oxygen consumed can generally be obtained. Examples of such wastes are distillery and soap manufacturing wastes. With oil refinery wastes, the O.C./B.O.D. ratio was found to vary from 0.77 to 6.1.

This project will continue using additional industrial wastes. It will probably be completed in about a year.

10. The Biochemical Oxygen Demand of Industrial Wastes (Naval Stores Waste). (C-2-9).

The biochemical oxygen demand of such wastes has been found to vary over a wide range, depending upon the concentration used in the determination. Such wastes have an immediate oxygen demand which is about five percent of the 5-day B.O.D. The immediate demand of such wastes upon a receiving stream depends upon the resultant pH.

This is part of an industrial waste survey by the Survey and Investigations Branch and will be completed shortly. No special paper is planned but results will be included in a paper on the comparison of B.O.D. and oxygen consumed tests (C-2-8).

11. Determination of Uranium. (C-2-10)

The emission spectograph is being used to determine quantitatively the amount of uranium present in water samples. The study is in its preliminary stage. It may be found that fluorometric methods will be more sensitive but these have not yet been studied.

This project will be continued for six months to a year.

12. Radioactive Wastes in Sewage. (C-3-7).

These studies are being made to determine the distribution of radioactive iodine and phosphorous wastes between sewage solids and the liquid phase in sewage. This information is needed to interpret the effect of isotopic wastes from hospitals and industries in sewage plants and streams.

Studies on radioactivity in connection with preliminary sewage treatment should be completed in about 6 months. Work on secondary sewage treatment is expected to continue.

13. Qualitative and Quantitative Study of Organic Chemicals Occurring in Raw and Filtered Water Supplies. (C-4-1).

Raw or filtered water is passed through activated carbon filters. The organic chemicals adsorbed on the carbon are extracted with an organic solvent. The solvent is then evaporated and the recovered material separated into

organic groups and semi-micro or micro analysis made of the constituents.

A preliminary paper entitled "A Study of the Concentration and Estimation of Organic Chemicals in Raw and Filtered Surface Waters" was presented at the American Chemical Society meeting in Detroit on April 17, 1950, and has been submitted for publication in Industrial and Engineering Chemistry. The project is a long-term one and will be continued for at least a year.

14. Development and Use of a Standard Odor Substance. (C-4-2).

The determination of threshold odor in water will vary with the olfactory sensitivity of the investigator unless a standard odor substance, to which the investigator may "calibrate" himself is utilized. Uniformity of reporting numerical threshold limits is also necessary. The Ohio River Valley Water Sanitation Commission requested that data be collected from various Ohio River cities, utilizing a standard procedure. A standard odor substance, n-butyl alcohol, was developed and procedure for making uniform odor determinations were prepared. ("Procedure for the Determination of Qdor on Ohio River Study" mimeographed). Sixteen waterworks operators are conducting tests two to three times weekly after having the procedure demonstrated to them. A preliminary report on the data was submitted for August, 1950. Other data are being assembled and it is expected that a comprehensive paper may be available about June, 1951.

15. A Study of the Products of the Reactions of Chlorine and Phenol in Dilute Solutions. (C-4-3).

Various ratios of chlorine and phenol are reacted in concentrations of a few parts per million or less. The resulting product is subjected to taste and odor tests to determine the products having the highest and lowest taste and odor intensities. Selected ratios of chlorine and phenol are then reacted in 60 gallon drums, the reaction product adsorbed on active carbon, extracted and identification attempted.

Laboratory work will be completed in about two to three months and a report may be available about June, 1951.

16. Threshold Concentrations of Taste and Odor on Organic Extract and Organic Groups from Raw and Filtered Water Supplies. (C-4-4).

Organic chemicals recovered from raw and filtered waters (see No.13 above) are weighed and diluted with odor-free water to a concentration where odor and taste are first detectable. This study should show which groups of chemicals or specific substances are most likely to cause taste and odor in water supplies.

This project is designed to give the comparative data for different materials extracted from water supplies and from the groups isolated in Project No.13 This project may be completed in about a year.

17. Activated Sludge from Common Foods for Radioactive Waste Treatment. Laboratory Studies. (C-5-1).

The activated sludge method of treatment was investigated as a possible means of removing radioactive materials from liquid wastes. Because there might not be sufficient domestic sewage at an installation where radioactive materials are discharged, a synthetic activated sludge was developed and fed common foods instead of sewage. Foods used were principally flour and dextrose with the addition of minerals, such as nitrogen and phosphorous. The best sludges were obtained with a diet of wheat-flour and dextrose, fortified with superphosphate and adjusted to a pH range of 7 - 9.

Laboratory work was completed in August, 1950, and a paper on this subject was presented at the American Chemical Society meeting in Chicago on September 8, 1950. This paper has been submitted for publication in Sewage and Industrial Wastes.

18. Effect of Toxic Materials on Activated Sludge. (C-5-2).

The effects of fluorides, copper, trivalent and hexavalent chromium, strontium and silver on activated sludge developed from domestic sewage were obtained. Laboratory work was completed in January, 1950, and the first draft of a paper has been prepared. Copper, hexavalent chromium and silver were toxic to the sludge in amounts less than 5 p.p.m. each. The other materials had no effect on the sludge quality in greater concentration. Fluoride present up to 500 p.p.m. and strontium up to 200 p.p.m. produced no effect. Trivalent chromium produced little or no effect in a concentration range of 20-40 p.p.m. A final report should be available on this study about June, 1951.

19. Citrate Removal by Activated Sludge and Trickling Filter Treatment. (C-5-3).

Studies were made with both sodium citrate and citric acid to determine if the compounds would be removed by normal aerobic sewage treatment methods. Either compound was readily assimilated by the sludge or filter growths up to a concentration of 1,000 p.p.m. in preliminary tests; however, the maximum concentrations produced some turbidity. Further studies, in which the citrate solution was applied over a 24-hour period (instead of instantaneously) and supernatant liquid was withdrawn three times daily (instead of once daily) indicate that concentrations in the range of 2,500 p.p.m. are assimilated by activated sludge.

A preliminary draft of a report has been prepared and the final report should be available in a few months.

20. The Effect of Wastes Containing Surfactants on Activated Sludge. (C-5-4).

A laboratory study to determine amounts of various types of surfactants that activated sludge can tolerate is being made. The effects on foaming and

settling characteristics are being studied by gradually adding increased amounts of surfactants to acclimated sludges until a sludge of poor quality is obtained.

About 75 percent of the laboratory work has been completed and a report should be available about June, 1951.

Biology Section

21. Review of Literature on the Toxicity of Wastes to Fish. (Bi-1).

A critical review of most of the published material on the toxicity of industrial wastes and their various components to fish has been undertaken as one of the projects of the literature review section (Section I), Sub-committee on Toxicity, Research Committee, Federation of Sewage and Industrial Wastes Associations. This review is not merely a summary of published results, as it involves careful appraisal of methods and conclusions through detailed, comparative study of most of the original data published during the past 40 years. The first part of the review, dealing with the toxicity of alkalies, acids and inorganic acids already has been published (Sewage and Industrial Wastes, Vol. 22, No. 11, pp. 1432-1458, 1950). Subsequent parts, which will be several years in preparation, will deal with the toxicity of inorganic salts, organic compounds found in wastes, and various complex industrial wastes.

22. Development of Toxicity Bioassay Methods. I. Oxygenation of Test Solutions. (Bi-2).

These studies are directed toward the refinement of techniques for the evaluation of the toxicity of industrial wastes to aquatic animals, as an aid to the control of toxic waste treatment and disposal. Improved methods are being developed for controlling experimental conditions in the course of these toxicity bioassays. Currently, the maintenance of adequate dissolved oxygen concentrations, through controlled oxygenation of test dilutions of wastes having a pronounced oxygen demand, without removal of volatile toxic components at an excessive or variable rate, is under study. This has involved detailed study of dissolved gas equilibria and exchanges in various experimental systems (aquaria). The above studies represent an important phase of the work of the Bioassay Methods Section (Section III) of the Sub-committee on Toxicity, Research Committee, Federation of Sewage and Industrial Wastes Associations, which has the function of promoting and coordinating related investigations.

23. Standardization of Practical Bioassays with Fish. (Bi-3).

This is the first of such projects undertaken by the Bioassay Methods Section (Section III) of the Sub-committee on Toxicity, Research Committee, Federation of Sewage and Industrial Wastes Association. A detailed outline of recommended methods for the evaluation of the toxicity of industrial wastes to fish is being prepared jointly for publication by this committee section,

which includes representatives of industry, State and Federal government agencies and academic and other research institutions. The objective of such [illegible] to promote uniformity and reliability in bioassay techniques, and the reporting of toxicity data and their publication to practical waste disposal problems. Most of the work connected with the first project is being done by an Environmental Health Center biologist, who organized the committee section and serves as its chairman. Two extended committee meetings for discussion of the joint recommendations already have been held. The preparation of similar recommendations concerning bioassays with aquatic organisms other than fish (for example, Daphnia, shellfish, etc.) also is planned.

24. Distribution of Fishes in Lytle Creek. (Bi-4).

A study is being made of the effect of Wilmington's domestic sewage on the distribution of fish in Lytle Creek. Collections are made each month from the stations above and below the sewage treatment plant and the specimens collected are preserved, identified and counted. To date over thirty-five different species of fish have been tentatively identified from Lytle Creek.

The total number of fish and the number of species increase as one collects further from the sewage treatment plant outlet. The area immediately below the sewage treatment plant is devoid of fish life.

It is hoped that the fish populations in Lytle Creek can be correlated with the chemical, physical and other biological data being collected by other sections of the Center.

This project will be continued for one or two years.

25. Survey and Mapping of Lytle Creek. (Bi-5).

During the past month the mapping of Lytle Creek was completed up to a point approximately 1/2 mile below the Wilmington Sewage plant. The stream is being mapped on a scale of 1 inch for each 20 feet of stream length. The length, width and depth of the riffles, pools and straight runs in the stream are being shown and related to the fall of the stream. From the surveying data and the map, it is planned to determine the total area of riffles, pools, and straight runs in each zone of the stream and determine the amount of natural stream purification occurring in each type of area.

All field work is completed and the map is nearly completed. There remains the determination of bottom areas and entering of some details such as vegetation, bottom type, etc.

26. Evaluation of Biological Indicators. (Bi-6).

Most previous work on evaluation of biological indicators of pollution has been based upon scattered records - often single notations - of the occurrence of organisms in polluted and cleaner water environments (Kolkwitz and Marsson, and others). This project is essentially a long term one, which relates the chemical, physical and bacteriological factors

to the distribution of organisms in Lytle Creek throughout all seasons of the year. A sub-project has been started to determine the value of stoneflies as indicators of clean vs. polluted water.

This project in its entirety is a long term one. Over a period of 50 years many of the organisms have been listed but we still have an incomplete idea of which ones are reliable. In order to obtain such information it will be necessary in many cases to culture the organisms and to test them under controlled environmental conditions.

27. Qualitative and Quantitative Bottom Studies - Lytle Creek. (Bi-8).

During the past one and one-half years, samples of macrofauna have been collected from riffles, pools and marginal areas of Lytle Creek each month. These samples are from five stations which represent all the zones of pollution and natural purification. It is proposed to tie in the data from these samples with the detailed map of the stream to determine the quantity of macrofauna in each zone and their role in the natural purification processes.

The field work for this project will be continued 6 months and the laboratory work for about a year.

28. Qualitative and Quantitative Plankton Studies - Lytle Creek. (Bi-11).

Water samples for plankton analysis were collected at various stations on Lytle Creek as a part of the intensive study of the stream, August 15-18, 1950. The plankton samples were concentrated and preserved preparatory to being analyzed for numbers and kinds of algae and other microorganisms present. This information is important in helping to interpret the process of natural purification of the stream below the point where it receives the sewage effluent.

This study should continue over a minimum period of two years, since the plankton are affected very appreciably by seasonal and local environmental changes.

29. Toxicity of Insecticides. (Bi-14).

Extensive mortality of fishes in southern cotton-growing areas, apparently attributable to the widespread use of some highly toxic insecticides for the control of the cotton-boll weevil, has been reported. The possibility of dangerous contamination of some domestic water supplies with these insecticides has been recognized, and goldfish sometimes have been used as test animals for the detection of such contamination. Experimental studies have been undertaken, therefore, in order to add to the available information on the toxicity of these insecticides to fish, and especially of the most recently developed insecticides (such as Aldrin), which have received little or no attention in the past. The minimum concentrations which are detectable by means of the above-mentioned aquarium tests with goldfish are receiving particular attention. The toxicity of samples of soils and stream-bottom mud from areas treated with insecticides (which may be leached from the contaminated soils) also is being investigated.

30. Biological Investigation of Experimental Waste Treatment Plant, Huntington, West Virginia. (Bi-15).

This project was undertaken by request of the Ohio and Tennessee Drainage Basins, Division of Water Pollution Control. Its purpose was to determine the amount and character of the growth of the experimental trickling filter and the effectiveness of such treatment on the oxidation of sulphides in the wastes. Chemical and biochemical tests were started at the same time by State personnel, but the work was discontinued because of unseasonably cold weather.

This project is completed.

SURVEY AND INVESTIGATION BRANCH

Field Survey Section

31. South Platte River Basin Water Pollution Investigation

This was a comprehensive investigation of water pollution problems in the South Platte River Basin (Colorado, Wyoming and Nebraska) conducted in cooperation with the Bureau of Reclamation, the City of Denver, and the Colorado State Health Department. It included field laboratory investigations on stream water quality, industrial wastes, municipal sewage, as well as engineering surveys of sources of pollution. From the standpoint of magnitude of pollution load the beet sugar industry presents one of the greatest pollution problems in this Basin. Major water use along the South Platte and tributaries is for crop irrigation and water resources are highly developed for this purpose. In many instances water used for the irrigation of truck crops is seriously polluted by sewage and industrial wastes. Field work on this project has been completed and a final draft of the report is now being prepared.

32. Mississippi River Water Pollution Investigation

This investigation is confined to the St.Louis metropolitan area and is being conducted in cooperation with the State Health Departments of Illinois and Missouri and the Bi-State Development Agency. As planned the survey will include determination of sources of pollution, stream water quality and industrial waste studies. This study is now in its initial stages. Laboratory facilities are being set up at the St.Louis Chain of Rocks Filtration Plant and final arrangements for the stream sampling program are being completed.

33. Etowah River Investigation

The study of the Etowah River in Georgia was undertaken during the Fall of 1950 at the request of and in cooperation with the Corps of Engineers, U. S. Army. It included determination of stream water quality above and

below the recently constructed Allatoona multi-purpose reservoir and biological investigations of the reservoir and the stream below it. Inasmuch as the water discharged from the reservoir was deficient in oxygen the investigation afforded an opportunity to investigate the reaeration of the stream in the reach below the dam. The report of this investigation is now in preparation.

34. Mahoning River Investigation

This project, which involved a study of the Mahoning River, was conducted at the request of and in cooperation with the Corps of Engineers, U. S. Army. The principal activity of this investigation was the estimation of monetary benefits resulting from flow regulation. Of special interest in this investigation was the determination of monetary benefits which would accrue to industrial users as a result of lowered cooling water temperatures in the stream.

35. Roanoke River Investigation

This project was conducted at the request of and in cooperation with the Corps of Engineers, U. S. Army, and involved the consolidation and bringing up to date of material included in the previous reports on water supply and pollution problems in Roanoke, Smith and Dan Rivers. The report is now complete except for final editing.

36. Bathing Water Quality Studies

The project was initiated to determine the effect of bathing water quality on health of bathers and to gather epidemiological data necessary for the formulation of national standards for bathing water quality.

Three studies have been made to date: of water in a large fresh water lake at Chicago, Illinois, in 1948; of a river water at Dayton, Kentucky, in 1949; and of ocean water at New Rochelle, N. Y., in 1950. The projects involved bacteriological determinations of water quality from daily samples and collecting information on the swimming and illness experience of some 8,000 people in each study. The resultant data were then analyzed to try to find a correlation between water quality and illness experience of swimmers.

Preliminary drafts (except for figures) of the reports on the Chicago and Dayton studies have been completed. Data on bacterial water quality for the New Rochelle study have been tabulated and the epidemiological records have been forwarded to the Division of Public Health Methods for tabulation and analysis, but no writing has been done on the report.

The results obtained to date do not allow exact conclusions to be drawn but indicate that bathing in water having a median coliform density of 2,300 per 100 ml. may cause an increase in gastro-intestinal illness.

Further studies of waters of various types and showing a high degree of bacterial pollution are needed before definite conclusions can be drawn. The fact that use of natural waters of high coliform density is discouraged or prohibited for bathing purposes may make it impossible to obtain the necessary

information by surveys of this type, and controlled experiments by a large group of volunteers may be required.

37. Research on Sanitary Quality of Irrigation Water

At present there are no satisfactory standards for measuring the sanitary quality of irrigation water. The regulations of the various states are quite variable and there has been a demand on the part of state water pollution control agencies for better yard-sticks for measuring the quality of such waters. Bacteriological research directed toward obtaining fundamental information on the influence of water quality on the irrigated crops has been initiated at Denver, Colorado. Epidemiological studies are also needed inasmuch as there are practically no data available on the epidemiological aspects of polluted irrigation water.

38. High Capacity Trickling Filter Study, Webster City, Iowa

The project was set up at the request of the Upper Mississippi-Great Lakes Board of State Sanitary Engineers to compare the efficiency and operation characteristics of high capacity trickling filters, using a process of direct recirculation of filter effluent to the filter influent line, with those employing the conventional recirculation of final clarifier effluent.

The field work was completed on December 8, 1950 and included chemical, biological, and physical examinations. Initial tabulation of flow data and laboratory results has been completed. Work has been started on computation of loadings applied to the various treatment units and the resulting treatment efficiencies.

Judged solely on the basis of results obtained to date direct recirculation is a process with promise. Further studies should be made, preferably at a plant with higher waste loadings on the filter and with higher recirculation ratios to determine if other plants produce similar satisfactory results.

39. President's Water Resources Policy Commission

Environmental Health Center personnel participated in committee activities in connection with the preparation of Volume 1 of the report entitled "A Water Policy for the American People." Reports on river basin water supply and pollution control problems were prepared and submitted to various Commission working committees for discussion. The majority of the material submitted to the Committee on the "Evaluation of Constructed Projects" was published in the recently issued General Report.

40. Arkansas-White-Red River Basins and New York-New England Inter Agency Committees

These committees were established by resolution of the Federal Inter-Agency Committee during 1950. The Public Health Service is represented on these committees by the River Basin Engineers in the Southwest-Lower Miss-

issippi and New England Drainage Basins. Representatives of the Environmental Health Center serve as consultants to the Public Health Service Committee Members on matters relating to water supply and water pollution. Future activities will include field laboratory stream surveys by Environmental Health Center personnel.

Industrial Wastes Section

During the seventeen months covered by this report, cooperative studies have been conducted with twelve industrial corporations operating plants which produce industrial wastes of major importance. These projects have included wastes from integrated steel mills with special emphasis on by-product coke operations, beet sugar, manufactured gas, Kraft pulp, and Gulf Naval Stores. A number of special studies have developed as an outgrowth of this work which might properly be termed practical or industrial research. A brief discussion of these special studies is given below.

41. By-Product Coke Plant Wastes

By-product coke waste studies were conducted at three plants with the objective of determining the principal factors influencing the characteristics of coke plant wastes. These studies indicated that the temperature of carbonization was the most important single factor. The volume of ammoniacal liquor produced per ton of coal charged is another major factor influencing the phenol content of by-product coke wastes. This phenomenon is an example of the well known law in physical chemistry which pertains to distribution of a solute between two immiscible solvents (Henry's Law).

Koppers Dephenolization of Ammoniacal Liquor

This system takes ammoniacal liquor from the base of the free leg of the ammonia still. In passing through the free leg of the ammonia still, some phenol is driven off with the free ammonia and enters the gas stream. Since the carryover from the free leg may vary between 10% and 40% of the phenol, the efficiency of the Koppers process is seriously affected. The amount of phenol carryover with the free ammonia can be minimized through by-passing some steam around the free leg of the ammonia still directly to the dephlegmator. Sodium phenolate produced by the Koppers process is said to be of excellent quality.

Benzol Extraction of Phenol from Ammoniacal Liquor

A few by-product coke plants extract phenol from ammoniacal liquor by absorption in benzol. Phenol is subsequently removed from the benzol through contact with caustic solution. Benzol is recovered and reused. The benzol extraction process is applied to ammoniacal liquor prior to its being introduced into the ammonia still. This procedure gives a higher overall efficiency in phenol recovery than is possible with the Koppers vapor recirculation process. The principal disadvantage of benzol extraction is the tendency to extract undesirable tar bodies which contaminate and result in an inferior grade sodium phenolate.

Ammonia Still Operation

Operation variables and their effect on still waste were explored for one ammonia still. The influence of high and low steam consumption, and high and low lime use were investigated at three different feed rates. The rate of feed of lime proved to be the governing factor in removal of ammonia, the removal being greatest for high lime feed. Cyanide reduction between still influent and effluent was greatest when the steam feed was high and the lime use low. Generally, high steam consumption resulted in maximum carryover of phenol into the gas stream.

Cooling Tower for Gas Final Cooler Water

Investigation was made of cooling towers for by-product coke gas final cooler recirculating systems as a means of reducing the cyanide content of by-product coke wastes. A substantial amount of hydrogen cyanide (HCN) was emitted to the atmosphere. It is conceivable that this cyanide laden air could contribute serious air pollution under certain conditions but no instances have come to our attention as yet. The indirect cooling system with coils provides an alternate for areas where emission of HCN to the atmosphere might create an air pollution problem.

Project Status

Field work and reporting on this project are essentially complete. One company has requested a recheck in an effort to explain relatively high phenol losses indicated by the cooperative study. Further work is contemplated in developing a cyanide balance at one cooling tower for gas final cooler water. Results of this work will serve as basis for revision of the existing Public Health Service Industrial Waste Guide to the coke industry.

42. Blast Furnace and Steel Mill Wastes

The objective of this work was to define characteristics of the principal wastes and to explore various facilities in use by the industry for minimizing pollutional waste discharges.

Blast Furnace Flue Gas Solids

The advent of the pressure top blast furnace is significant from the standpoint of reducing solids in the blast furnace flue gases. This is reflected not only in the dry solids recovered but also in the flue gas wash water. This study indicated a reduction of approximately 30% suspended solids in the flue gas wash water.

Rolling Mill Wastes

The pickling liquor problem of steel plants has been the subject of extensive research. However, less is known regarding oil and mill scale losses. Pressure lubricated roll bearings were a significant source of waste oil, losses being dependent largely on seal and packing maintenance. These oil losses were reduced somewhat by use of water lubricated phenolic bearings.

A second source of waste oil was that sprayed on the metal being rolled where lubrication was necessary to preserve the metal and roll surface. Considerable mill scale was wasted to the sewers, a result of inadequate sedimentation facilities.

Project Status

Reports have been prepared in draft form for two steel mills and two sets of blast furnaces. It is possible that additional field work may be required to provide basis for an Industrial Waste Guide on the subject of blast furnaces and steel mills.

43. Manufactured High B.T.U. Gas Wastes

Use of gas oil in production of high B.T.U. gas has introduced new problems in tar-water separation. The principal sources of wastes entering the tar separators are from the wash boxes and scrubbers. Wastes entering the tar separators contain, in addition to tar, cracked oil and some gas oil. These materials tend to emulsify. Intermittent operation of stand-by gas plants has prevented a comprehensive study of this industrial waste problem.

44. Beet Sugar Plant Wastes

It has been conservatively estimated that the population equivalent of beet sugar wastes in the United States, during the operating season, amounts to 5,000,000 persons. Cooperative studies were conducted at four beet sugar refineries with the objective of evaluating this problem, investigating waste treatment, and exploring reuse of pulp screen water and pulp press water.

Reuse of Pulp Screen Water and Pulp Press Liquor in Beet Sugar Manufacture

Opportunity was afforded to evaluate reuse of pulp water and pulp press liquor after treatment with chlorine. This was a plant scale demonstration. Elimination of these wastes from the plant sewers substantially reduced the net pollution load. The company reported a slightly reduced sugar yield in the bag and somewhat higher sugar content in the molasses, a condition indicative of interference with crystallization.

Pilot Plant Treatment of Beet Sugar Wastes

This work demonstrated the efficacy of fine screening, lime treatment and chlorination of pulp water and pulp press liquor. Lime treatment consistently removed over 90% of the suspended solids. Under favorable conditions, a 30% B.O.D. reduction was accomplished by lime treatment. Lime treatment was likewise effective in destruction of thermophilic bacteria. Limited experimental work was done with chlorination. It was shown, however, that high bacterial kills could be accomplished for this waste by chlorine dosages as low as 7 ppm and 10 minutes contact time.

Beet Sugar Waste Studies

Cooperative studies were made of one straight house and one Stoffen's

plant. This work revealed pulp silo drainage from one straight house producing wastes equal to 48% of the total for that plant. This revelation focused attention on the importance of drying pulp as a stream pollution abatement measure.

Inspired by these cooperative studies, the cooperating company has this year converted one beet sugar Steffen's house to a system which provides heat treatment and reuse of screened pulp press liquor. Further plant scale experiments to be conducted include use of screened pulp press liquor for dilution of molasses in the Steffen's department. This same company has developed a modified process for manufacture of glutamic acid from which monosodium glutamate is made. The concentrated end liquor from this process will be incorporated with pressed pulp and subsequently dried to produce high grade cattle feed. Adoption of these recovery systems leaves only flume water which can be recirculated and filter cake which can be lagooned.

Status of Project

Field work and reporting on this project are complete. A draft of an Industrial Waste Guide for the beet sugar industry has been prepared and is now being reviewed by authorities on the subject.

45. Kraft Pulp Mill Wastes

In this study wastes from a Kraft pulp mill were correlated with the receiving stream. Significant losses of calcium carbonate and pulp were observed. Sodium sulfide proved to be a minor pollutional constituent. The merits of counter current pulp washing were well demonstrated. Bottom studies of the receiving stream revealed a virtually barren zone for some distance below entry of these wastes. These conditions prevailed even though dissolved oxygen levels were satisfactory for fish.

The field work for this mill study has been completed and a report is being prepared. It is planned to study at least two additional Kraft pulp mills with the view of incorporating information obtained from this work into an Industrial Waste Guide for the Kraft pulp industry.

46. Gulf Naval Stores Wastes

A field project is currently under way for study of the characteristics of process wastes from extraction of turpentine, rosin, pine oil, and similar products from long leaf yellow pine stumps. There are 13 of these plants located in 5 Gulf states. Two processes are employed, one employing naphtha extraction and the other using a benzol extraction. A plant employing naphtha extraction is currently being studied and study of the benzol extraction process is planned.

Appraisal of this problem will be made when sufficient waste data are available. If it appears that the pollutional effect of these wastes is of sufficient magnitude, it is proposed to prepare an Industrial Waste Guide covering this industry.

47. Engineering Investigations

In addition to the foregoing, some 18 engineering investigations have been made of industries having waste problems. These investigations have been made in cooperation with Basin and State engineers. In some instances, preliminary studies have been made to indicate the sanitary quality of the receiving waters.